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Keywords

Sialis, Chauliodes, Corydalus, Nigronia, Climacia, Sisyra

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THE AQUATIC NEUROPTERIDA OF IOWA

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Abstract.—The fauna of aquatic Neuropterida of Iowa is documented. We list one species of dobsonfly, three species of fishflies, four alderflies (Megaloptera), and two spongillaflies (Neuroptera). New Iowa distributional records are reported for *Protosialis americana* (Rambur), *Sialis joppa* Ross, *Sialis mohri* Ross, *Nigronia serricornis* (Say), *Climacia areolaris* (Hagen), and *Sisyra vicaria* (Walker).

Key Words: *Sialis*, *Chauliodes*, *Corydalus*, *Nigronia*, *Climacia*, *Sisyra*

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Neuropterida is a monophyletic group within Holometabola that includes Raphidioptera (snakeflies, all terrestrial), Megaloptera (dobsonflies, fishflies, and alderflies, all with aquatic larvae), and Neuroptera (lacewings, a few families with aquatic immature stages). The diversity and distribution of aquatic Neuropterida (Megaloptera, Neuroptera) in Iowa is poorly documented. Species-level records for these insects are useful to researchers doing stream assessments or ecological studies because it increases the level of understanding of aquatic resource condition and allows for a more precise estimate of impairment (Guerold 2000, Feio et al. 2006). It also is important to document the range of this fauna in the state because many of Iowa's streams are becoming increasingly impaired and species presence could be lost before they are documented (USEPA 2016).

The primary and historic ecosystems of Iowa were temperate prairies and savannas in most of the state with forested flood plains along streams (Smith 1998). Most streams in this area are characterized as warm water and they are typically turbid. In contrast, the driftless area (Paleozoic Plateau) of northeastern Iowa has a steep, hilly topography with greater forest coverage, and it includes some coldwater streams and springs (Fig. 1). Much of the Iowa landscape has been altered due to extensive agricultural practices and urbanization (Smith 1998). Only about 1% of the historic tallgrass prairie in Iowa remains.

Several previous studies have provided some insight on the diversity of aquatic Neuropterida in Iowa. For example, Jaques (1935) listed *Sialis infumata* Newman, *Chauliodes rastricornis* Rambur, and *Corydalus cornutus* L. as occurring in Iowa, but he did not provide any specific locality data. Tarter et al. (1976) reported *Chauliodes pectinicornis* L. and *Chauliodes rastricornis* from Iowa apparently not being aware of Jaques

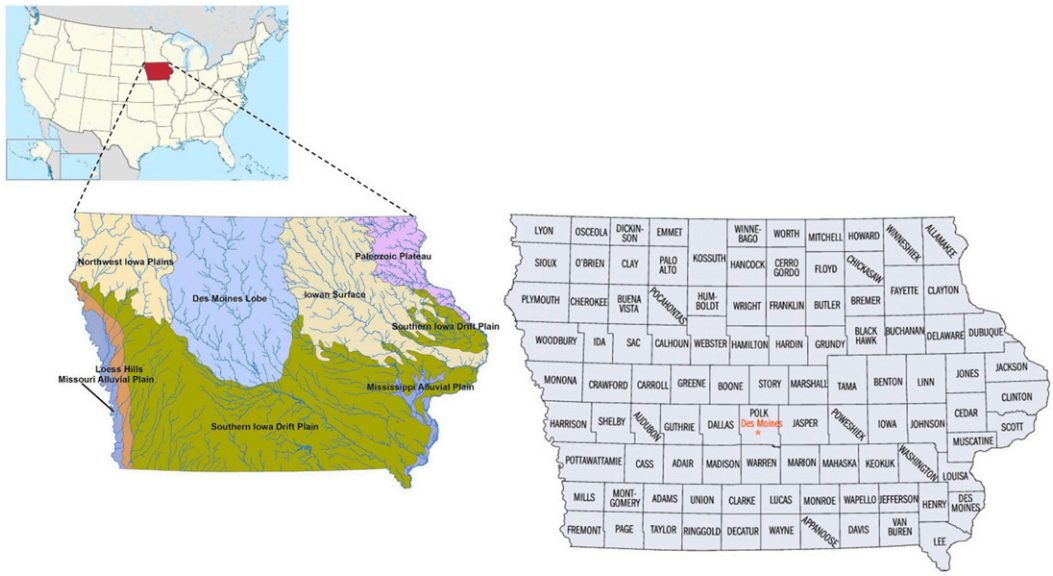


Fig. 1. Maps of Iowa showing primary ecological regions and counties. Base map of landforms by Bill Whittaker at English Wikipedia, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=6520775

(1935) report of the latter species. Meierhoff and Prill (1982) and Contreras-Ramos (1998) also reported *C. cornutus* from Iowa. A few other ecological studies have documented megalopteran occurrences from Iowa, but specific identifications were not provided (Moen 1953, 1955; Meierhoff and Prill 1982; Hubert et al. 1984; Kennedy and Miller 1990). No previous reports of Sisyridae, the only aquatic Neuroptera family in the Nearctic Region, have been published for Iowa (Bowles 2006).

This paper describes the distribution of aquatic Neuropterida in Iowa, and includes several species not previously reported from the state. We also characterize the larval habitats where known.

Methods and Materials

We examined preserved specimens (pinned and alcohol) in the Iowa State Insect Collection (ISIC). Jaques (1935) noted that examples of those species where deposited in the "Iowa State College Collection" (ISIC). It therefore is quite possible those collection localities are captured in this study, but we cannot be certain. Data included in brackets were deduced from other available label data. Dissection followed standard procedures (i.e., Contreras-Ramos 1998). Specimens are preserved in ~75% ethyl alcohol or pinned. Adult terminalia were cleared in ~10% sodium hydroxide (NaOH) solution for 8–10 h. Cleared terminalia were rinsed with alcohol and placed in microvials containing glycerine. We also include photographs of live specimens to illustrate color patterns.

Additionally, some records for Iowa specimens were taken from BugGuide.net and iNaturalist.org using photographs published on those websites. We did not examine specimens listed on BugGuide or iNaturalist and only photographs that unambiguously depicted

the species are reported here. Therefore, these records are included for supplemental purposes. Using photographs from a public media source are not a substitution for examination of physical specimens, but they are an important and valid means to learn more about the distribution and phenology of species. Internet archival services, such as the WayBack Machine (archive.org/web/), maintain copies of BugGuide and iNaturalist taken at multiple instances in time, which allow future review of records reported here. We obtained additional distributional records from The University of Iowa, State Hygienic Laboratory, Coralville, Iowa (http://www.shl.uiowa.edu/contact/), and Iowa Department of Natural Resources, BioNet, Des Moines, Iowa (https://programs.iowadnr.gov/bionet/). The distributional records from those two organizations are recorded only as present because actual numbers of specimens recorded are unknown.

Results and Discussion

We report two families, five genera and eight species of Megaloptera, and one family, two genera and two species of Neuroptera. Keys that include the species reported in this paper can be found in Engel (2004), Bowles (2006), and Bowles and Sites (2015).

Order Megaloptera
Family Corydalidae
Subfamily Chauliodinae

Chauliodes pectinicornis L.

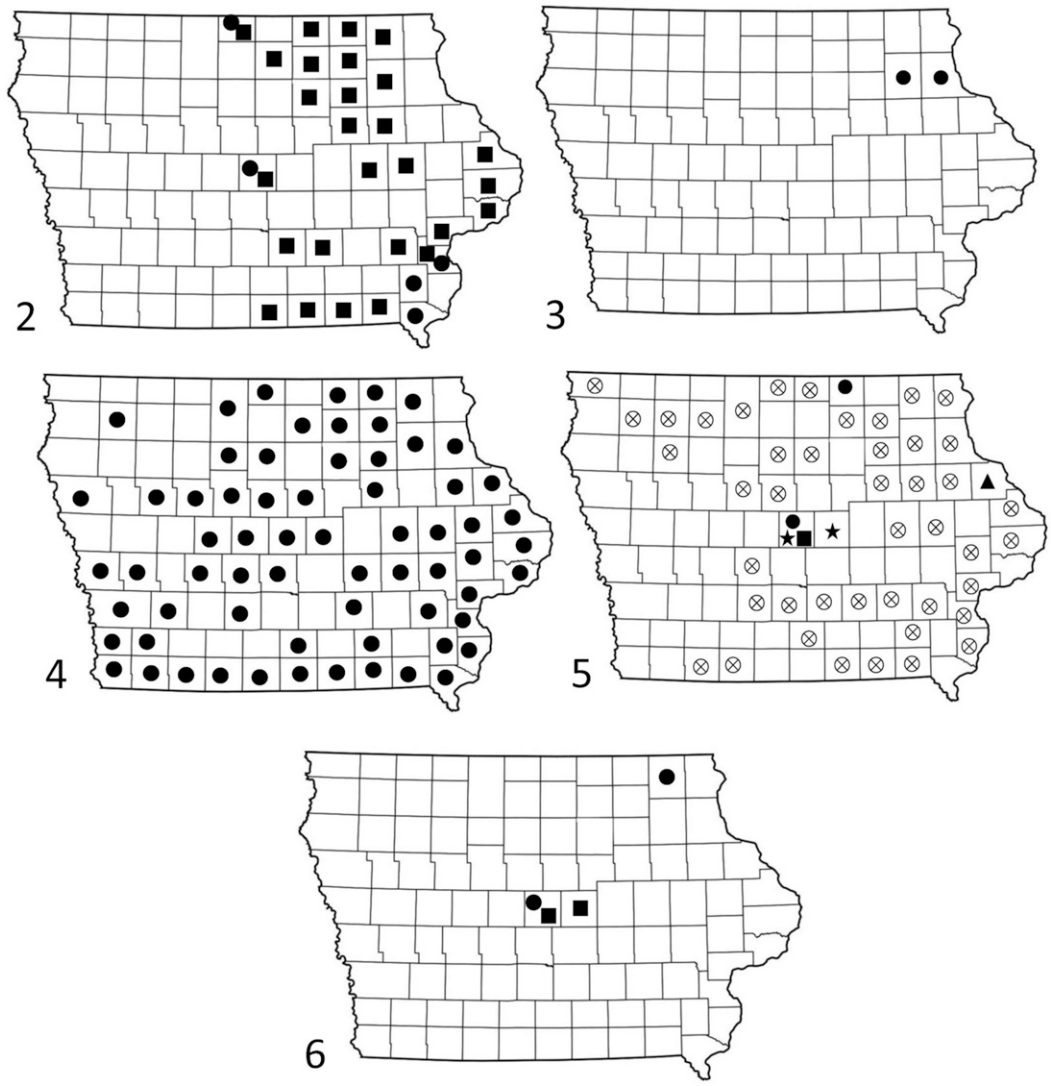
Tarter et al. (1976) reported this species from Winnebago County. We add an additional record from Story County based on a single specimen (Figs. 2, 11). The University of Iowa State Hygienic Laboratory and Iowa Department of Natural Resources list this species as occurring in Henry and Louisa counties based on larval specimens, and the latter agency reports an additional record for Lee County. The number of specimens examined by those organizations is not known. This species likely occurs elsewhere in the state. Larvae of this species occur in lentic habitats, including ponds, marshes, and swamps (Cuyler 1958, Tarter et al. 1976, Bowles and Sites 2015). The flight period in Iowa is during August and September.

Chauliodes rastricornis Rambur

Tarter et al. (1976) reported this species from Story County (Figs. 2, 12). We report an additional record from Linn County. BugGuide photos show this species from Story and Winneshiek counties (BugGuide.net Photos #1622133, 1622134, 1622135, 883513), and iNaturalist shows a record from Black Hawk County (photo #25765961). Both the University of Iowa State Hygienic Laboratory and the Iowa Department of Natural Resources list larval records of this species from Appanoose, Cerro Gordo, Fayette, Howard, Linn, Mitchell, and Muscatine counties. The University of Iowa State Hygienic Laboratory reports additional records from Chickasaw, Marion, Muscatine, Scott and Winnebago counties, while the Department of Natural Resources reports it from Benton, Bremer, Buchanan, Butler, Clinton, Davis, Floyd, Jackson, Louisa, Mahaska, Van Buren, Washington, and Wayne counties. The number of specimens included in those records is not known. Larvae of this species have been found in lotic and lentic habitats including ponds, swamps, marshes, and small springs and seeps (Tarter et al. 1976, Bowles and Sites 2015). The flight period in Iowa is during May and July.

Nigronia serricornis (Say)

We did not examine any specimens of this distinctive species from Iowa. The University of Iowa State Hygienic Lab-



Figs. 2–6. Distribution maps. 2, ● *Chauliodes pectinicornis* (L.), ■ *Chauliodes rastricornis* Rambur. 3, *Nigronia serricornis* (Say). 4, *Corydalus cornutus* (L.). 5, ■ *Protosialis americana* (Rambur), ● *Sialis infumata* Newman, ▲ *Sialis joppa* Ross, ★ *Sialis mohri* Ross, ⊗ *Sialis* spp.. 6, ● *Climacia areolaris* (Hagen), ■ *Sisyra vicaria* (Walker). Refer to individual species accounts in the text for sources of data.

oratory and the Iowa Department of Natural Resources both report this species (as larvae) from Clayton and Fayette counties in northeastern Iowa (Figs. 3, 13). The number of larval specimens in those collections is not known. We have seen photographs of one of those specimens and we concur with the identification. This species generally inhabits small to mid-sized, clear-flowing streams, and springs. Thus, its distribution in Iowa may be restricted to the driftless area (Paleozoic Plateau) in the northeastern portion of the state. In the Interior Highlands, the flight period for this species is during May, which is likely similar to the

flight period in Iowa (Bowles and Sites 2015).

Subfamily Corydalinae

Corydalus cornutus L.

This is the most widespread megalopteran in Iowa, and it likely occurs statewide in suitable streams (Figs. 4, 7–10). Jaques (1935) and Penny et al. (1997) both gave general records of this species from Iowa but they did not provide any county-level collection data. Contreras-Ramos (1998) reported *C. cornutus* from Boone, Fayette, Johnson, and Linn counties. We have records of 18 specimens (5 males, 13 females) from among Boone, Clinton, Dallas, Dubuque, Floyd, Jones, Muscatine, Polk, Story, Webster, and Woodbury counties. The University of Iowa State Hygienic Laboratory larval records include Appanoose, Benton, Butler, Cass, Cedar, Cerro Gordo, Clayton, Davis, Decatur, Freemont, Greene, Hamilton, Hardin, Henry, Howard, Jackson, Jones, Louisa, Lucas, Madison, Mahaska, Mills, Mitchell, Page, Pottawattamie, Poweshiek, Sac, Taylor, Van Buren, Wapello, Washington, and Winnebago counties. Additionally, Iowa Department of Natural Resources larval records include Black Hawk, Bremer, Calhoun, Clinton, Dallas, Delaware, Des Moines, Dubuque, Guthrie, Fayette, Harrison, Humboldt, Iowa, Kossuth, Lee, Marshall, Montgomery, O'Brien, Ringgold, Shelby, Webster, Wayne, and Wright counties. The number of larval specimens in those collections is not known. iNaturalist shows additional records from Scott and Winneshiek counties (photos #32065611, 7613290). Larvae, or hellgrammites, are commonly found under rocks in clear, flowing streams, and more rarely on woody snag habitat in stream pools (Bowles and Sites 2015). Emergence typically is during June and July.

Family Sialidae

Protosialis americana (Rambur)

We have records of this species (four males, two females) from Story County from specimens collected during June and July 1929, and June 1930 (Figs. 5, 15). An additional specimen was collected by the junior author in June 2019. These collections represent a new state record for this species. *Protosialis americana* is known to be associated with both lentic and lotic habitats, including springs.

Specimens examined.–IOWA: [Story Co.], Ames, 21.vi.1929, H. H. Knight, 1 male, 1 female (ISIC); same but 14.vii.1929, Hastabe, 1 male, 1 female (ISIC); same, but 16.vi.1930, H. M Harris, 1 male (ISIC). Story Co., Ames, 1916 Meadowlane Ave, 42°02.51′N 93°36.28′W 285 m, 19.vi.2019, G. W. Courtney, at black-light, 1 male (ISIC).

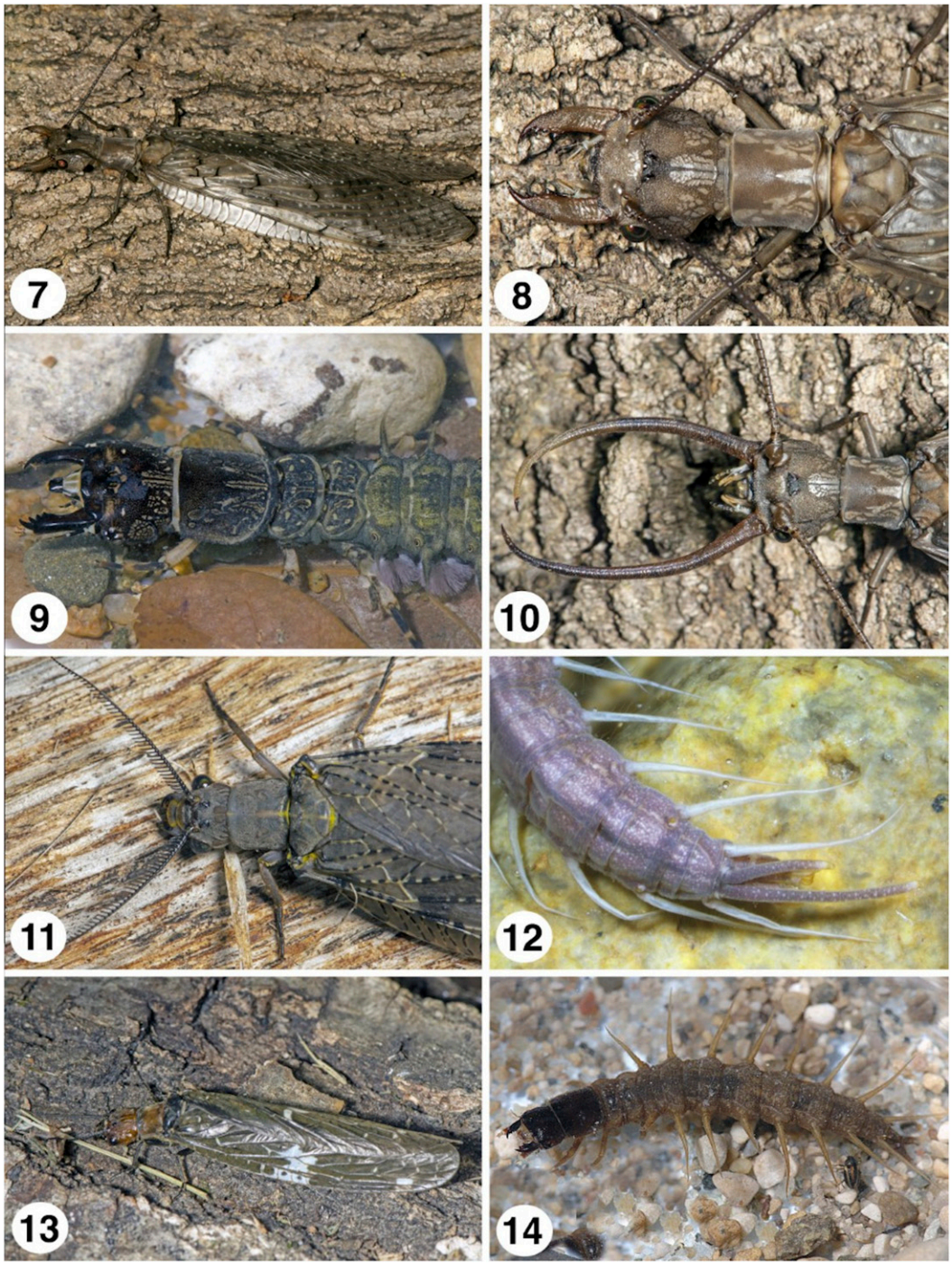
Sialis infumata Newman

We have records of this species from Mitchell and Story counties, based on two male specimens collected during May (Fig. 5). Because Jaques (1935) recorded only the presence of this species in Iowa, we include the specific collection data for our records. Bowles and Sites (2015) reported this species from both streams and impounded waters. The adult and larva of *Sialis* sp. are shown to illustrate the general habitus of this genus (Figs. 16–17).

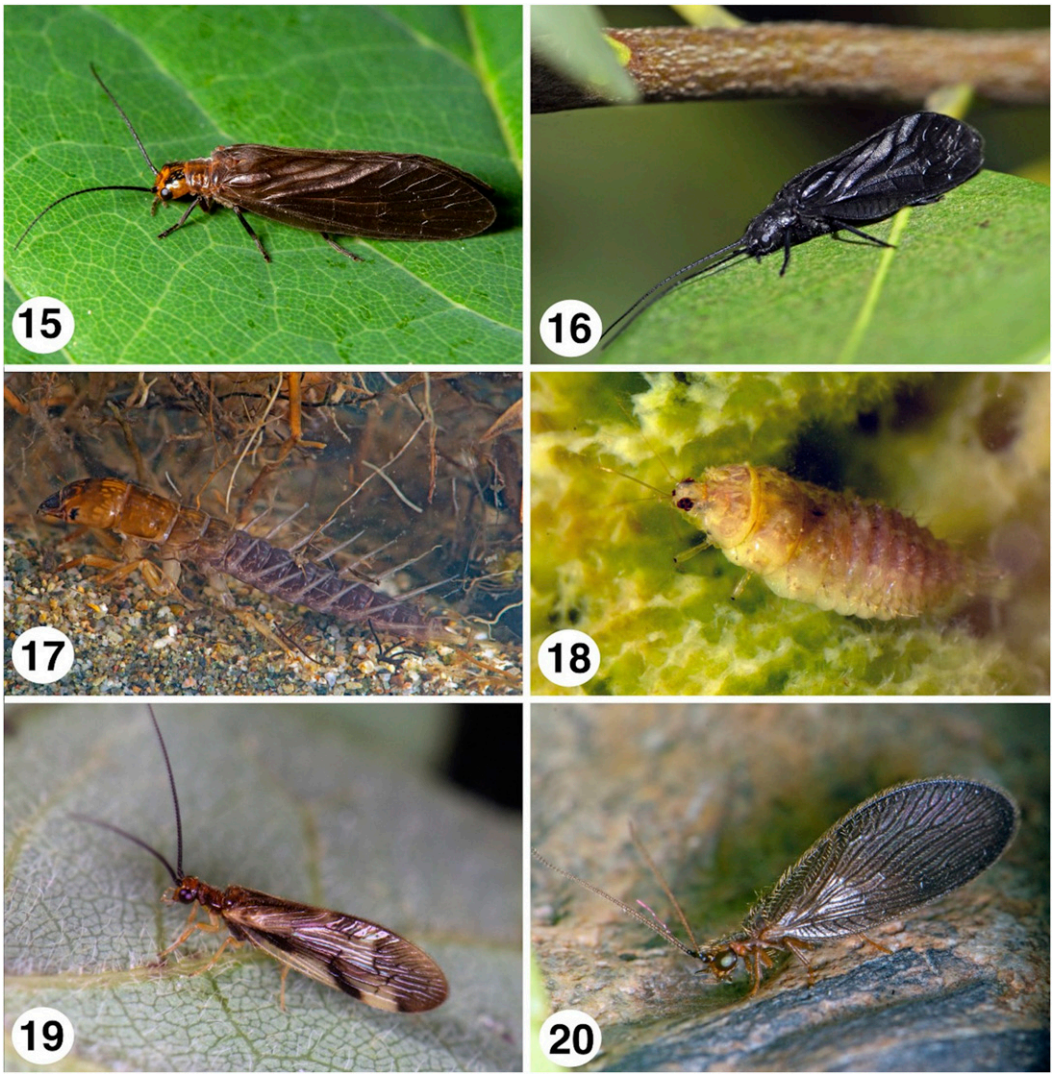
Specimens examined.–IOWA: Mitchell Co., 1.v.1977, W. M. McKinley, 1 male (ISIC); [Story Co.], Ames, 14.v.1950, W. E. Pickium, 1 male (ISIC).

Sialis joppa Ross

We examined a single collection of this species consisting of 41 adult specimens collected during May and June



Figs. 7–14. 7, *Corydalus cornutus* (L.) female, habitus. 8, *C. cornutus* female, head and anterior thorax. 9, *C. cornutus* larva, head, thorax and anterior abdomen. 10, *C. cornutus* male, head and prothorax. 11, *Chauliodes pectinicornis* (L.), male, head and thorax. 12, *C. rastricornis* larva posterior abdomen. 13, *Nigronia serricornis* (Say) female, habitus. 14, *N. serricornis* larva, habitus. Figures 7–13 © G.W. Courtney; Figure 14 © S.A. Marshall.



Figs. 15–20. 15, *Protosialis americana* (Rambur) male, habitus. 16, *Sialis* sp. male, habitus. 17, *Sialis* sp. larva, habitus. 18, *Climacia californica* Chandler larva, habitus. 19, *Climacia areolaris* (Hagen) female, habitus. 20, *Sisyra vicaria* (Walker) female, habitus. All figures © G.W. Courtney.

from Dubuque County in the driftless area (Fig. 5). These collections represent a new state record for this species. Larvae seem to inhabit colder streams and springs (Bowles 1989, Bowles and Sites 2015), and this species is unlikely to occur outside the driftless portion of the state.

Specimens examined.–IOWA: Dubuque Co., Swiss Valley Nature Center tributary of Catfish Creek, 42°25.31′N, 90°45.44″W, 3.v–27.vi.2007, M. Wihlm, Malaise trap, 9 males, 32 females (ISIC).

Sialis mohri Ross

This species presently is known only from Marshall (two males) and Story counties (two males) all collected during May (Fig. 5). These collections represent a new state record for this species. It likely

occurs elsewhere in the state, particularly at large reservoirs, small impoundments, and larger rivers (Bowles and Sites 2015).

Specimens examined.–IOWA: [Story Co.], Ames, 4.v. 1977, D. P. Whittlesey, 1 male (ISIC). Same, 10.v.1949, Marvin, 1 male (ISIC). Same, but 11.v.1977, W. T. Edwards, 1 male (ISIC). Marshall Co., 14.v.1978, W. J. Knox, 2 males (ISIC).

Sialis spp.

Larval sialids have been collected from a variety of habitats and many counties in Iowa (Fig. 5). Those specimens cannot be reliably identified to the species level and therefore only genus-level records are listed. The majority of these records are from the Iowa Department of Natural Resources and the University of Iowa State Hygienic Laboratory, and we were unable to determine how many specimens were included in those records. It is also possible that some larval specimens identified as *Sialis* are now recognized as *Protosialis*, but we have no way of making that determination.

Order Neuroptera
Family Sisyridae
Climacia areolaris (Hagen)

Bowles (2006) did not report this species from Iowa. We report records based on 32 specimens from Story Co. (South Skunk River) and Winneshiek Co. (Upper Iowa River), which represent new state records for this species (Figs. 6, 19). Specimens were collected from July through September. The Iowa Department of Natural Resources lists records of this genus based on larvae (likely *C. areolaris*) from Buchanan, Fayette, Johnson, and Mitchell counties, based on an unknown number of specimens. We did not examine those specimens and were unable to verify the identifications. The University of Iowa State Hygienic Laboratory lists an additional larval record from Mitchell County. The larva of a closely related species, *Climacia californica* Chandler, is shown to illustrate the general habitus of this genus (Fig. 18). Larvae are typically found in medium- to large-sized streams, lakes and impoundments where they are associated with freshwater sponges and bryozoans (Bowles 2006).

Specimens examined.–IOWA: Story Co., S. Skunk River @ Carr Park, 42°02.35′N 93°36.16′W 275 m, 30.viii.2018, G. W. Courtney, at black-light, 2 females (ISIC); same, but 2.ix.2018, 2 female (ISIC); same, but 27.viii.2018, 1 male, 2 females (ISIC); same, but 19.viii.2019, 1 male (ISIC); same, but 16.ix.2019, 2 males, 3 females (ISIC); same, but 17.ix.2019, 5 females (ISIC); same, but 18.ix.2019, 5 females (ISIC); same, but 20.ix.2019, 5 females (ISIC); same, but 30.ix.2019, 1 male (ISIC). Story Co., S. Skunk River above Carr Park, 42°02.64′N 93°36.23′W 275 m, 17.ix.2019, G. W. Courtney, black-light trap, 1 male (ISIC). Winneshiek Co., Upper Iowa River above Coldwater Creek Road, 43°25.92′N, 92°00.55′W, 340 m, 26.vii.2010, M. J. Hatfield, black-light, 2 females (ISIC).

Sisyra vicaria (Walker)

Bowles (2006) also did not report this species from Iowa. We have records of four specimens of this species from Marshall and Story counties, which represent new state record (Figs. 6, 20). Specimens were collected in July through September. The Iowa Department of Natural Resources lists larval records of this genus (likely *S. vicaria*) from Hardin and Van Buren counties, but the number of specimens they collected is unknown. The University of Iowa State Hygienic Laboratory also reports an additional record from Van Buren County. We did not examine those specimens and were unable to verify the

identifications. Larvae are typically found in small- to medium-sized streams, lakes, and impoundments where they are associated with freshwater sponges and bryozoans (Bowles 2006).

Specimens examined.–IOWA: Marshall Co., Arney Bend Wildlife Area, 27.viii.2004, Fabio R. & Norman D. Penny, 1 female (California Academy of Sciences); Story Co., Ames, 524 River Oak Drive, 42°03.14′N, 93°37.00′W, 290 m, 1.vii.2005, Joel Coats, 1 female (ISIC). Story Co., S. Skunk River above Carr Park, 42°02.64′N 93°36.23′W 275 m, 25.viii.2019, G. W. Courtney, black-light trap, 1 male (ISIC). Story Co., S. Skunk River @ Carr Park, 42°02.35′N 93°36.16′W 275 m, 18.ix.2019, G. W. Courtney, at black-light, 1 female (ISIC).

Potential Species Occurrences in Iowa

Other species expected to occur in Iowa, but not collected by us or others, include the fishflies *Neohermes concolor* (Davis) and *Nigronia fasciata* (Walker) given their respective distributions in neighboring states (Bowles and Sites 2015). The senior author has seen multiple examples of *N. concolor* from northern Missouri near the Iowa border. The alderflies *Sialis itasca* Ross, *Sialis velata* Ross and *Sialis vagans* Ross also are expected to occur throughout Iowa given their respective known widespread distributions in the central and Midwestern states (Whiting 1991, Bowles and Sites 2015).

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